Fabricating unity: the FAO-UNESCO Soil Map of the World

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Abstract: *»Einheit schaffen: Die FAO-UNESCO Weltbodenkarte«*. As a contribution to the United Nation's "Development Decade" of the 1960s, the UN FAO and UNESCO collaborated to produce a Soil Map of the World. Because of soil's privileged place in mid-twentieth century conservationist thought and its material characteristics, which were extraordinarily resistant to standardized classification, analysis of this project reveals with particular clarity how scientists made knowledge about the global environment in the international community. Producing credible global environmental knowledge required a worldwide network of disciplined observers, but soil scientists understood the Soil Map of the World as a means to produce this transnational community of experts. At a scale of 1:5 million, the units of the map applied to no place in particular; it was a heuristic device. The legend, which presented a new international classification system, was the critical accomplishment because it promised to unify diverse national soil science communities in a single discipline. The rigorously empirical descriptions of soil categories reveal the interplay of the cosmopolitan values of scientific internationalism with the nationalist tensions of the Cold War and decolonization.

Keywords: Soil Map of the World, UN Food and Agriculture Organization, collective empiricism, internationalism, classification.

1. Introduction

When a citizen of the twenty-first century worries about the global environment, she is most likely contemplating the global climate – or perhaps the planet's forest cover, fisheries, or biodiversity. Even if she is concerned about the global food supply, she is probably not thinking explicitly about the world's soil. But for conservationists in the middle of the last century, soil held a privileged, almost sacred, position. Soil erosion was the final cataclysm towards which all of modern society's little sins against the earth converged; it was akin to climate change today. As the most fundamental renewable resource, soils both reflected and determined the health (that is, the carrying capacity) of eco-

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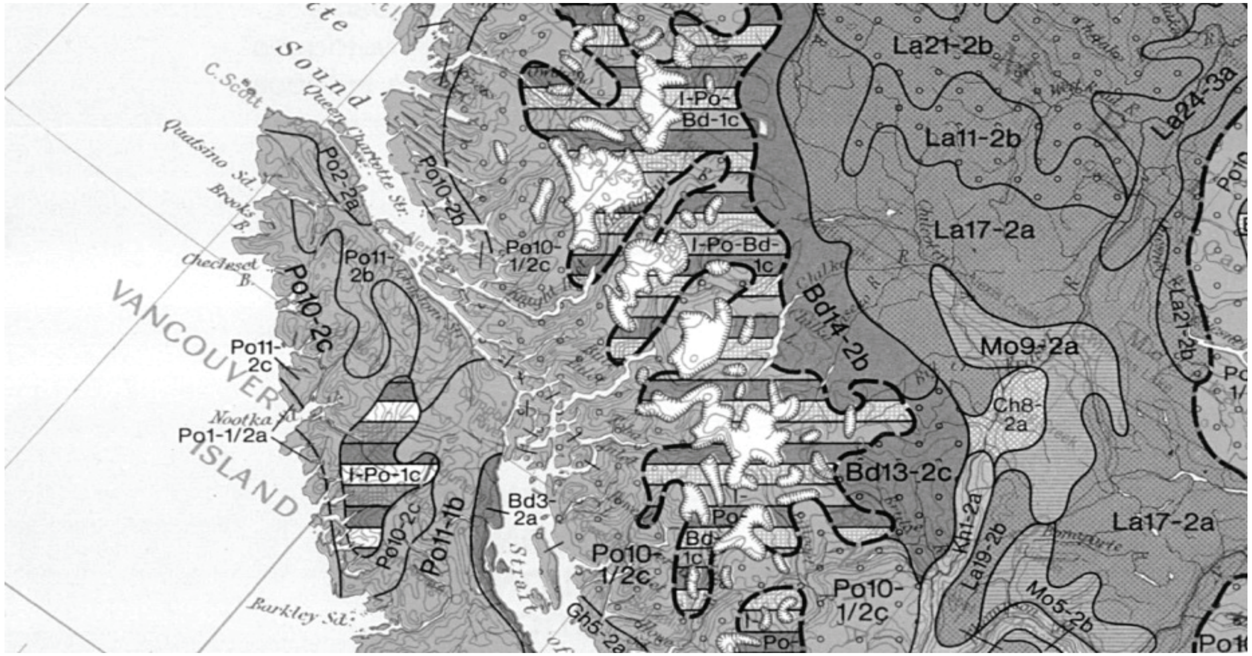
systems – and of the human communities that depended on them. Especially in the context of Malthusian anxieties regarding rapid population growth, gaining a comprehensive understanding of the global distribution of soils was a critical step in realizing the conservationists' dream of rationally managing the world's natural resources (Bashford 2014). Seen in proper historical perspective, then, the UN Food and Agricultural Organization (FAO) and United Nations Educational, Scientific, and Cultural Organization (UNESCO) *Soil Map of the World*, begun in 1961 and finally completed two decades later, represents a critical yet neglected episode in the construction of global environmental knowledge.

The production of the Soil Map of the World reveals the practices that produced a global, synoptic "view from above." What makes the Soil Map of the World such a revealing epitome of the view from above, however, is not just its significance in the ideology of resource conservation. Rather it is the daunting challenges posed by the cultural meanings of soil, which conflict with the values of a global synoptic perspective, and by the material characteristics of soil, which resist standardization. For Bruno Latour, these qualities are what make soil mapping an illuminating example of the tedious work scientists perform to create "immutable mobiles" that circulate around the world; for Geoffrey Bowker, they make soil taxonomy the exemplar of hard to classify nature (Latour 1999; Bowker 2005). By analyzing how scientists confronted these daunting challenges to produce standardized knowledge out of the apparently boundless diversity of soils, this paper shows not only how international experts made global environmental knowledge, but how this and countless similar postwar projects co-produced – and were *intended* to co-produce – transnational communities of experts (Jasanoff 2004).

The making of the Soil Map of the World illuminates the dynamics of the postwar period in which extensive resource surveying built the global knowledge infrastructure on which the explosion of environmental modeling from the 1970s on depended (Edwards 2006; Aronova 2015, in this HSR Special Issue). Historians of the environmental sciences have amply demonstrated the enormous significance of Cold War security concerns and military patronage in big science studies of the world's oceans, atmosphere, and even bird migrations (cf. Cloud and Reppy 2003; Hamblin 2005; Higuchi 2010; MacLeod 2001). But UN specialized agencies and affiliated international nongovernmental organizations provided a critical alternative set of institutions that also determined the structure, function, geography, and norms of the postwar global knowledge infrastructure. These institutions were saturated with politics, of course, but often, as in the case of the Soil Map of World, the Cold War was just one force, and not a dominant one, determining knowledge production.

Figure 1: Detail of the FAO-Unesco Soil Map of North America (1975)



The lines and colors, words and numbers, symbols and scale of the map instantiated international, bureaucratic, and disciplinary politics, as well as intellectual traditions and internationalist convictions. For the layman, a first encounter with the FAO-UNESCO Soil Map of the World is overwhelming; a meaningless jumble of colors rather than a standardized simplification of natural order (Fig. 1). At a scale of 1:5,000,000, it took eighteen 76 cm by 110 cm sheets to cover the terrestrial planet (excluding Antarctica). These eighteen sheets were organized into nine areas. An explanatory text accompanied each area, and the legend required an additional map sheet and text. Together, the eighteen sheets graphically displayed "a first appraisal of the world's soil resources." They showed the distribution of 106 distinct classes of soil, termed Soil Units, each represented by a color. Similarities between soils were suggested by color "clusters" so that large swathes of red and pink in Central Africa or a broad band of peach and orange in Southeastern North America revealed major soil regions. Patterned overlays, termed phases, represented important characteristics affecting agriculture, such as stoniness or salinity, that were not included in the definition of soils. Finally, alpha-numeric symbols indicated three degrees of relief (from gently undulating to mountainous) and soil texture (from coarse to fine). This code also corresponded to a key on the back of each map that named other soils making up more than 20 percent (associated soils) and additional important soils comprising less than 20 percent (inclusions) of a delineated area. The combination of colors, patterns, letters, and figures made up some 5,000 unique map units. Although the place names of the 1942 American Geographical Society base map remained visible beneath the gaudy patterns, the map presented a world without political borders. The patches of red banding the tropics did not symbolize the territorial claims of the British Empire, but rather the predominance of Ferralsols. The patterns revealed by the Soil Map of the World were esoteric, but the basic message was clear: the great commonwealth of man was dependent on the planet's finite soil resources and, therefore, on the scientific elite who could decipher the map's meaning (FAO 1971-1981).

The ambition to oversee the utilization of soil resources on a world scale resonates with familiar depictions of the view from above as an imperial, authoritarian perspective. Mathew Edney began his seminal study of the cartographic construction of British India by invoking Borges' "famous fantasy of an empire so addicted to cartography that its geographers constructed an 'unconscionable' map at the same size as the empire itself." The illusion of a perfect correspondence between the territory and the emperor's knowledge of it, Edney argues, was at the core of empire and made cartography the quintessential imperial science (Edney 1997, 1). Similarly, James Scott has emphasized the oppressive potential of state-sponsored large-scale development schemes based on a synoptic perspective that inevitably represents only a thin simplification of nature and society (Scott 1998; Anker 2001). In important respects, the Soil Map of the World fulfills these expectations. It embodies the high modernist values of universal knowledge legible only to an elite class of cosmopolitan experts.

And yet soil represented a fundamental problem for the global view from above. It is, as the cliché goes, what local communities are rooted in. Knowledge of a particular soil has traditionally been understood to derive from the virtuous experience of working the land (Cohen 2009). In terms of legitimacy, expert knowledge and lay experience with soils met on relatively level ground. And at a scale of 1:5,000,000, the Soil Map of the World was the very antithesis of Borges' fantasy. It was at once so obviously a thin simplification that governments wondered what useful purpose it could possibly serve, and yet so complicated it defied commonsense interpretation. Indeed, convincing the UN specialized agencies' member states to invest scarce resources in what turned out to be a twenty year project to produce a map at the dubious scale of 1:5,000,000 was an accomplishment in its own right. Nevertheless, many of the experts who collaborated in its construction worried more about users mistaking the map for reality than defending its verisimilitude.

For soil scientists, the most important effect of the map would be to resolve the terminological Babel that undermined international scientific communication. When FAO and UNESCO initiated the Soil Map of the World project in 1961, no international soil classification existed. Many countries, in fact, had multiple competing regional classifications or were in the process of developing national systems. Soil surveyors often relied on officially obsolete systems or invented *ad hoc* classifications depending on the soils and the intended uses of a particular survey. Under these conditions, it was impossible to achieve any plausible semblance of collective empiricism, which demands that observers in distant locations make sense of the world through a standardized categorization (Daston and Galison 2007). For soil scientists, then, it was not the eighteen sheets of maps that were the project's enduring accomplishment, but the legend, which proposed a new, international classification system. The legend provided a common currency for exchanging information. In this sense, the map was a heuristic device intended to cultivate an international community of soil scientists.

The process of international collaboration was supposed to produce reliable knowledge with worldwide legitimacy. I call the epistemological strategy of coordinating diverse national perspectives to produce credible knowledge the "view from everywhere" (Selcer 2008). The view from everywhere was an attempt to use the problem of subjectivity to create a more perfect objectivity. In part, it emerged out of the liberal democratic principles and bureaucratic politics of the UN System. The map, then, can be understood as an instrument of representational democracy as much as authoritarian imperialism. The tension between the map's dual objectives as an instrument of development planning and as a heuristic device for integrating diverse points-of-view into an international perspective, between the view from above and the view from everywhere, is a central theme of this paper.

This tension was inherent in the project; indeed, it was institutionalized in the liberal democratic norms of the UN System, which mandated geographic representativeness even in international scientific projects in which participants were selected for their technical competence. The first section, therefore, describes the international and bureaucratic political opportunity structures that made the Soil Map of the World possible. The following section focuses on the peculiar intellectual, material, and disciplinary challenges of making soil data global. The final section analyzes how the tensions between the view from above and the view from everywhere played out in the production and interpretation of the Soil Map of the World.

2. The International Political and Institutional Conditions of Possibility

To produce the Soil Map of the World, experts had to negotiate international, bureaucratic, and disciplinary politics. Although the very mention of bureaucracy risks a reflexive glazing over of the eyes, it is impossible to understand the practice of science in the UN System without analyzing interactions between national governments, intergovernmental organizations, and nongovernmental organizations (Weiss, Carayannis and Jolly 2009). By the 1960s, the initial unabashed idealism of internationalists that had animated the halls of UN agencies in the late 1940s was tempered by the realities of Cold War politics. But decolonization offered new opportunities for, in the terminology of the political scientist Daniel Carpenter, forging bureaucratic autonomy – as UN agencies took over the developmental missions of colonial governments, budgets ballooned and mandates expanded (Carpenter 2001; Barnett and Finnemore 2004). And, as this section shows, the era's political tensions could make the ideals of scientific internationalism all the more precious to the experts who chose to participate in UN projects.

Soil scientists did not foreground their internationalist ambition to create a community of experts that transcended political divisions in official planning documents. Rather, because funding depended on the approval of their member states, FAO and UNESCO proposals for a Soil Map of the World clearly expressed the values of the view from above. Soil scientists explained that as the first global inventory of soil resources, the map would reveal the potential of the world's last agricultural frontier, the uncultivated soils of the tropics. Exploiting these vast reserves would require further scientific research, of course, but here, too, the map was vital. Experts explained that it would "supply a scientific basis for the transfer of experience between areas with similar environments" – the map as analogy generator. Moreover, a map based on a standardized classification system would enable systematic, controlled experimentation and the rapid extrapolation of findings on experimental farms to analogous areas. As the last sheets were being readied for publication, two key figures in the success of the project, Michel Batisse of UNESCO and Rene Dudal of FAO, invoked the requisite martial metaphor to describe the map's potential in the war against nature: "Perhaps this is a first step towards the 'ultimate agricultural weapon' which will make it possible to know what can be produced, under what conditions, with what interventions and at what risk, in any part of the world" (Dudal and Batisse 1978, 6).

Experts' promise that the Soil Map of the World would contribute to economic development appealed to governments. The project officially began in 1961, just a few months before President Kennedy proclaimed the 1960s the Decade of Development at a meeting of the UN General Assembly. As a review of the history of UN development concluded, planning was "priority number one" of the Development Decade. The goal of integrated planning at the national, regional and world scales reinforced UN agencies' proclivity for surveying; planned programs were supposed to be keyed to specific targets that were based on empirical assessments of needs and potential (Stokke 2009, 141-3). The promise of a global inventory of the world's soil resources resonated with the period's renewed emphasis on planning.

FAO's area of competence positioned the organization to take advantage of increasing development funding in the 1960s, and a new Director-General, B. R. Sen, revitalized the moribund organization. Sen sought to recapture FAO's original energy and imagination through a high profile Freedom from Hunger campaign. Like the Development Decade itself, however, the Freedom from Hunger campaign combined grand ambition with a limited budget. "The role of FAO would be generally that of a catalyst and coordinator of these world-wide efforts," Sen informed the 1,400 attendees of the opening session of the Seventh International Congress of Soil Science in Madison, Wisconsin. By alerting the world to the horrifying facts and the potential of technical expertise to solve the problem, FAO would galvanize the political will to win "the greatest challenge of our time – the conquest of hunger" (Sen 1961, xiii-xiv; Staples 2006, 105-22; Cullather 2010).

The International Congress of Soil Science, held just weeks after the Freedom from Hunger Campaign was launched, fit the method and message of the campaign perfectly. The congress' motto was "Alleviate Hunger, Promote Peace Through Soil Science." Graphically displaying the self-consciously broad perspective of participants in the congress, leading soil scientists, generally employed by national government agencies, presented small-scale soil maps of South America, Sub-Saharan Africa, Australia, Western and Eastern Europe, the Soviet Union, and Asia. In true catalytic fashion, Sen's encouragement of the work of the International Soil Science Society instigated a feedback loop: the congress passed a resolution calling for FAO to publish these seven small-scale maps, which initiated the Soil Map of the World project. Although governments, intergovernmental and nongovernmental organizations are often implicitly conceptualized as competing in a sort of zero sum game for international influence, the history of the Soil Map of the World suggests how porous the boundaries separating these institutional types were in practice; the UN System should be analyzed as a complex inter-institutional field, of which officially affiliated nongovernmental organizations like the International Soil Science Society were integral components.

The head of FAO's soil survey work, Luis Bramao, proposed that his organization publish the maps with a uniform legend and scale – a subtle shift that fundamentally transformed the task from a minor service to a major international project. Bramao's objection to simply publishing the maps was that they did not use the same cartographic conventions, terminology, and legend; they were based on different proportions of empirical data, reasoned inference and wild speculation; and they expressed differing conceptions of the significant differentiae of soils (Krasilnikov et al. 2009; Simonson 1987; Hollis and Avery 1987). Their publication without standardization would simply compound confusion. Instead, Bramao argued, FAO and UNESCO should synthesize the maps to produce a Soil Map of the World with a unified, international legend.[1]

At UNESCO, the Natural Sciences Department's new Director, Victor Kovda – a Soviet soil scientist who had presented the Soil Map of Asia at Madison – agreed with Bramao. They easily convinced the Dutch Secretary-General of the International Society of Soil Science (ISSS), Hans van Baren, to interpret the congress' resolution as an endorsement of the Soil Map of the World project. Within weeks, the two specialized agencies decided that the Soil Map of the World would be a joint project coordinated by a new World Soil Resources Office at FAO under the direction of Bramao.

An Advisory Panel – initially consisting of the lead authors of the maps presented at Madison plus experts from France, the United States, and India – met in June 1961 to select a base map and establish the principles and methodology for synthesizing global soil knowledge into a single map. Initial projections anticipated the project costing $176,000 and completed by the Eighth International Congress of Soil Science in Bucharest in 1964.[2] The project would make a mockery of the budget and timeline, but the basic operating plan worked remarkably smoothly. Indeed, for a joint project of two mutually suspicious specialized agencies involving cooperation between experts from the three worlds of the Cold War, the Soil Map of the World was organized with incredible speed.

What made the apparently mundane task of creating a uniform legend a decade-long major international project was precisely what made the endeavor so important to soil scientists. Out of the Babel of incompatible national soil classi-

[1] Luis Bramao to R. Schickele, 28 Sep. 1960, UNESCO/FAO Relations & Cooperation in the Field of Natural Science, 1956-1964, UN18/7, FAO.

[2] FAO/UNESCO Proposal for the Publication of The Soil Map of the World, n.d.; Michel Batisse to Luis Bramao, 9 Dec. 1960 in UNESCO/FAO Relations & Cooperation in the Field of Natural Science, 1956-1964, UN18/7, FAO.

fications, it required constructing a new system to serve as a sort of *lingua franca* for a transnational community of soil scientists. For FAO and UNESCO, coordinating the construction of a universal classification system for this key natural resource would help make them indispensable nodes in the international network of development agencies; it would enhance their reputation for competence and thus bolster their bureaucratic autonomy.

But these bureaucratic ambitions were not mere petty politics; they also expressed the deeply felt ideals of the scientific vocation. Thus, the unusual cooperation between UNESCO and the fiercely territorial FAO was cemented in the friendship between Kovda, a proud representative of Soviet science in the international community, and Bramao, the scion of a distinguished Portuguese family (the man FAO chose to send to Franco's Spain for the 25th anniversary celebrations of its National Research Council): "If the culmination of our official activities was our full agreement in every aspect of scientific cooperation," Kovda confided in a personal note, "so the culmination of our private friendship was the wonderful dinner given to Madame Kovda and myself in an ancient Rome tavern."[3]

International relations constituted a weightier context than personal relations, of course. As shown in the following section, U.S. soil science provided a common point of reference for the international collaboration. It was fitting that the Soil Map of the World used the American Geographical Society's topographic map as its base map. And in a less direct and material but just as fundamental manner, the tradition of Russian soil science also underlay the whole project.

But neither the Soviet Union nor the United States was a particularly active participant in the project. The U.S. Soil Survey Staff, after all, had already published a soil survey handbook that was the international standard and a comprehensive classification explicitly intended to be the international standard. The Soviets, for their part, were busy trying to reconcile four competing national systems. And neither country's bureaucracy made participating in UN projects easy. Confident in the importance of soil surveys and of their own preeminence in the field, the United States and the Soviet Union were not hostile to the Soil Map of the World project. But, absorbed in their own affairs, they left the leadership of the project to the Europeans – in particular, the Dutch and Belgians.

Since its founding in 1924, the International Soil Science Society had had only two Secretary-General's, both Dutch. F. A. van Baren was Secretary-General from 1950 to 1974, when Rudy Dudal, a Belgian and the international

[3] Victor Kovda to Luis Bramao, 17 October, 1960, UNESCO/FAO Relations & Cooperation in the Field of Natural Science, 1956-1964 UN18/7, FAO.

correlator of the Soil Map of the World, assumed the position.[4] But the Low Countries influence was due to more than an intimate network or institutional history. In 1955, Bramao had toured European soil survey institutions to recruit for FAO fellowships and technical assistance assignments. Although British and French experts, like the Americans, were occupied with assignments overseas or in national surveys, he found "great interest on the part of Dutch soil scientists in obtaining ETAP [Expanded Program for Technical Assistance] assignments."[5] If anything, the Belgians were more enthusiastic about UN work, and Bramao recruited three experts on the spot. One of these was the young Dudal. These small nations, both with agricultural research and development experience in enormous tropical colonies, found a comfortable niche in international soil science.

The reason for Dutch enthusiasm for UN work was obvious. In 1957, a FAO official reported on the difficulty of recruiting soil experts with knowledge of tropical and desert environments – and the impossibility of attracting U.S. or Canadian experts on the UN's salary schedule – but pointed out optimistically "that some countries which in the past had Colonial possessions, have, at the present time, a surplus of well-trained personnel – some of these countries desire, in fact, 'to export the brains' (the Netherlands falls into this category and the United Kingdom may soon be similarly placed)."[6] British and French ex-colonial experts would play key roles in the production of the Soil Map of the World – the French government, for example, seconded an expert to the World Soils Resources Office to assemble the final draft of the map and write the explanatory text for Africa. But in this project, the disproportionate influence of Dutch and Belgian experts, both suddenly left with so much less soil to study, was unmistakable. This reflected the traditionally outsized role of small European nations in international organizations and the fact that, in the 1960s, UN development programs functioned, in part, as jobs programs for former colonial powers (cf. Hodge 2010). If the Cold War was peripheral, decolonization was the central political force shaping knowledge production in the UN System during the 1960s.

[4] The porous boundaries separating nongovernmental and intergovernmental organizations were further dramatized by the fact that Victor Kovda, Director of UNESCO's Natural Sciences Department, nominated Rudy Dudal for the position.

[5] Luis Bramao, "Report on Trip to European Soil Survey Centres, 25 May-10 June, 1955, in folder, TRAVEL – Dr. Bramao's Trip to Ceylon and Middle East. 16 March – 9 April, Box Land and Water Development Division, Land and Water Use Branch (Soils (2)) 10AGL570, FAO.

[6] Ignatieff to 5 February, 1957, Soil Survey and Fertility General, 1956 to 1965, LA-2/I, FAO.

3. The Intellectual Conditions of Possibility

Ideas about soil and the material peculiarities of soil were as significant factors in the genesis of the Soil Map of the World as were international politics and bureaucratic ambitions. The material characteristics that make soil such a vivid symbol of local identity – its boundless variability – made it particularly resistant to the standardization necessary to achieve the view from above. Soils are not discrete entities; they form a three dimensional continuum across the earth's surface with more or less obvious boundaries between types. Moreover, the important differentiae for a map of a single farm at a scale of 1:1,000 could not be shown on a county soil map at a scale of 1:50,000, let alone a sheet of the Soil Map of the World. Different scales, therefore, required mapping units with different levels of specificity. Ideally, these different levels would be categories of a hierarchal system, so that the specific soil depicted on the detailed map of a farm would be included in the more general categories of soils covering that location on the maps of the county, region, and world.

Unfortunately, it was far from obvious which characteristics were appropriate differentiae for higher or lower categories – a soil at the lowest (most specific) category routinely contained properties belonging to unrelated classes at a higher (more general) category. The elite soil scientists who fashioned classification systems and created small-scale maps thus grappled with the fundamental intellectual problem of the global view from above: reconciling the global and local scales. Understanding how interactions between politics and ideas, institutions and material nature determined the resolution of this problem requires delving into the technical details.

For all the diversity of terminology and competing systems of classification, there was at least broad agreement on what a soil was. Contemporary soil scientists traced their discipline's origins to the articulation of the modern concept of soils in the late-nineteenth century by the Russian scientist Vasily Dokuchaev. Dokuchaev held that given sufficient time, environmental factors acted on rock to produce a new "independent natural-historical body," the solum in pedological terminology.[7] According to the U.S. Soil Survey Staff's 1951 *Soil Survey Manual*, the international standard reference for postwar soil surveyors,

> Soil is the collection of natural bodies occupying portions of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter, acting upon parent material, as conditioned by relief, over periods of time.

The *Soil Survey Manual* described the Russian revelation of soil as an independent body as "a revolutionary concept, as important to soil science as anat-

[7] Pedology could be used synonymously with soil science, but generally denoted that aspect devoted to classification, survey, and genesis.

omy to medicine." It "made a soil science possible" by enabling the direct, synthetic study of soil "morphology" (Soil Survey Staff 1951, 3). Morphology was meant quite literally. "Mature soil" was an organized body that could be dissected to understand the relations of parts to the whole.

In the field, soil scientists dug pits or sunk augers to study soil *profiles*, vertical, two-dimensional cross-sections of the solum (Fig. 2). Profiles were made up of soil *horizons*, horizontal layers of soil produced through the interactions of soil-forming factors (i.e. climate, relief, flora and fauna, geology, and time). Building on Dokuchaev's famous studies of the dark and deep Chernozem, soil scientists had defined a normal pattern of "master horizons," labeled A, B, and C horizons. Profile descriptions did not strictly follow this ABC pattern (one or more master horizons were often missing, a single horizon could reveal properties of two master horizons, etc.) and national surveys added their own master horizons over the years. Furthermore, each unique soil bore witness to the nearly infinite permutations of soil-forming processes. In the reports that accompanied soil maps, a detailed account of a soil profile included qualitative description, texture assessments, standardized color names and values, and various quantitative measurements of properties such as Ph and cation exchange. Like any dissection, each soil profile description revealed a familiar pattern and a unique body.

Even with this flexibility, however, one of the great challenges of postwar soil science was adapting a concept of soil derived from studies of recently glaciated landscapes in the temperate humid North to other areas. An important master horizon in one region could seem like a trivial sport of nature somewhere else. The implicit norm of the ABC soil profile was especially problematic for deciphering the ancient soil landscapes of Sub-Saharan Africa and Australia, which, unlike the relatively young post-Ice Age soils of North America and Eurasia, had evolved through multiple bio-climatic eras (Laker 2003; Stephens 1963). For postwar pedologists, however, the most urgent practical questions revolved around the exotic soils of the humid tropics, many of which appeared not to conform to temperate expectations. A Canadian participant in the Fifth International Congress of Soil Science in the Belgian Congo, the first outside of Europe, expressed a common anxiety:

> Not being familiar with tropical soils, the featureless nature of their profiles and the lack of distinct pedogenetic horizons was rather disappointing to me […] This makes one wonder how much stress should be placed in these soils on some of the commonly accepted morphological characteristics (Stobbe 1955).

The internationalization of soil science thus called into question basic assumptions regarding the key characteristics that differentiated soils. It challenged the fundamental soil concept around which the discipline was organized, and threatened its status as a science capable of producing universal truth – were the laws that governed soil formation in the steppes of Central Asia the same as in the jungles of Central Africa?

Figure 2: A U.S.D.A. Profile Description from the North American Volume of the FAO-UNESCO Soil Map of the World

ORTHIC LUVISOL	**Lo**
Classification (USDA)	Ultic Hapludalf, fine-silty, mixed, mesic
Location	Posey County, Indiana
Altitude	125 m (approximately)
Physiography	3 to 4% slope; no or slight erosion
Drainage	Well drained
Parent material	Wisconsin loess
Vegetation	Maple, tulip tree, beech and elm (*Acer* spp.; *Liriodendron tulipifera*, *Fagus* and *Ulmus* spp.)
Climate	Mesic; humid

Profile description

Ah	**0-2**	**inch**	Very dark greyish brown (10YR 3/2 moist) silt loam; weak fine granular structure; friable when moist; numerous fine feeder tree roots; abrupt smooth boundary; 0.25 to 2 inches of accumulation of recent leaves on surface, very few leaves present from previous year.
E1	**2-4**	**inch**	Dark greyish brown to dark grey (10YR 4/2 to 4/1 moist) silt loam; some penetration of Ah in worm holes and along small cracks; weak fine subangular blocky structure; friable when moist; abrupt smooth boundary.
E2	**4-10**	**inch**	Brown (10YR 4/3 moist) silt loam; penetration of Ah in root channels and worm casts; weak to moderate fine subangular blocky structure; friable when moist; abrupt smooth boundary.
BA	**10-15**	**inch**	Yellowish brown (10YR 5/4 to 5/6 moist) silt loam; moderate fine subangular blocky structure; friable when moist; clear smooth boundary.
Bt1	**15-19**	**inch**	Brown (7.5YR 4/4 moist) heavy silt loam; very thin coating of light brownish grey to pale brown (10YR 6/2 to 6/3 moist) on most peds; dark brown (7.5YR 4/4 to 4/2 moist) clayskins are common; moderate medium and coarse subangular blocky structure; firm when moist; clear wavy boundary.
Bt2	**19-31**	**inch**	Brown to strong brown (7.5YR 4/4 to 5/6 moist) light silty clay loam; dark brown (7.5YR 4/3 moist) clayskins are common; pale brown (10YR 6/3 dry) occurs along vertical cracks; cracks up to 0.12 inch wide decrease with depth; a few very dark brown (10YR 2/2 moist) thin coatings and streaks present; weak medium prismatic to moderate to strong coarse subangular blocky structure; very hard when dry and firm when moist; clear wavy boundary.
Bt3	**31-37**	**inch**	Strong brown (7.5YR 5/6 moist) light silty clay loam; reddish brown (5YR 4/3 moist) clayskins are numerous; yellowish brown (10YR 5/4 moist), light grey (10YR 7/2 dry) streaks and crack fillings; cracks are up to 0.25 inch in diameter; numerous very dark brown (10YR 2/2 moist) thin coatings and streaks; moderate coarse and very coarse subangular to very weak coarse prismatic structure; very hard when dry and firm when moist; gradual wavy boundary.
BC	**37-49**	**inch**	Brown to strong brown (7.5YR 4/4 to 5/6 moist) silt loam; a few reddish brown (5YR 4/3 moist) clayskins; very few very dark brown (10YR 2/2 moist) thin coatings and streaks; a few thin coatings and a few crack fillings of brown (10YR 5/3 moist) light grey (10YR 7/2 dry); very weak very coarse subangular blocky structure; very hard when dry and friable when moist; gradual wavy boundary.
C	**49-66+**	**inch**	Brown to strong brown (7.5YR 4/4 to 5/6 moist) silt loam; a few streaks of brown (10YR 5/3 moist); massive; hard when dry and friable when moist.

But making sense of the vertical dimension of a soil was the easy part; determining the boundaries of a soil laterally was when the solidity of the solum threatened to dissolve into mere dirt. A scientific classification, experts argued, required pedologists to isolate the "soil individual" from the seamless continuum. Yet soils on either side of a cartographic boundary were likely more similar to each other than to soils at the center of a map unit (Cline 1949, 1963).

The international standardization of soil classification depended on U.S. innovations, so it is essential to understand how the U.S. Department of Agriculture's Soil Survey resolved the problem of identifying soil boundaries. Beginning in 1951, Guy D. Smith, Director of Soil Survey Investigations for the U.S. Soil Survey, headed a highly collaborative effort to devise a completely new, comprehensive, rigorously logical classification system. The new system went through a series of "approximations." The first two approximations circulated to a select few experts in the United States, but then Smith sent each successive version to an ever wider community of soil scientists, including foreign scientists, for critique and field testing. Indeed, the U.S. Soil Survey intended the classification system to be global. The point was explicit in the seminal *Soil Classification: A Comprehensive System, 7th Approximation*: the first three of four exemplary soils used to illustrate its conception of the soil individual were from Belgium, Australia, and Canada (Soil Survey Staff 1960, 3-4). And Smith first presented the Seventh Approximation at the 1960 International Congress of Soil Science in Madison. Thus, although U.S. scientists did not present a continental map at the meeting, they presented an even more ambitious framework for controlling global soil knowledge. The Advisory Panel of the Soil Map of the World co-opted Smith to represent the United States, and agreed to use the *7th Approximation* as a "correlating medium" between the classification systems of different continents (FAO 1963b, 13).

The ultimate goal of the system was to create a natural taxonomy of soils. But unlike actual living organisms, soils were not the product of biological evolution – similar soils may have been formed by similar environmental conditions, but they were not related through reproductive history. There was not even the illusion that the real evolutionary family tree could be discovered, and so "natural" taxonomy had a special meaning. "Classifications are contrivances made by men to suit their purposes," began the *7th Approximation*'s theoretical chapter on classification. "They are not themselves truths that can be discovered […] the best classification is that which best serves the purpose […] for which it is to be used" (Soil Survey Staff 1960, 6). The solution to the problem of ordering the boundless diversity of soils lay in imposing human logic on nature, not in discovering nature's logic. Agreeing on where to draw the line between soils depended upon social conventions, not natural properties.

In these circumstances, a natural taxonomy meant not a technical one. A technical classification system was one created for a specific application, such as farm planning or road construction. In contrast, the goal of a natural taxonomy was to further science: "the purpose of a classification is to arrange the ideas of the objects in such order that ideas accompany or succeed one another in a way that gives us the greatest possible command of our knowledge and leads most directly to the acquisition of more" (Soil Survey Staff 1960, 6). The natural system, therefore, took into account all the significant traits of a soil, not just the ones relevant for corn growth or canal building. Since it (ideally) encompassed all of the properties that affected soil behavior, any technical classification – even ones as yet unanticipated – could be derived from the natural taxonomy.

Of the many radical innovations of the *7th Approximation*, probably the most radical was the claim to rigorous empiricism: unlike previous systems, it was based only on morphology, not on genetic processes. Genetic classifications defined categories in terms of the factors that theoretically determined a soil's development, such as climate or geology; for example, a Soviet scheme grouped soils in categories like "polar-boreal group of soil formation." But even the best soil scientists often were unsure or disagreed on the genetic process that produced particular horizons. The definitions of soils in the *7th Approximation*, therefore, sought to include only properties present in the soil, preferably properties that could be quantified. The goal was to construct

> a system of classification that can be applied uniformly by competent soil scientists working independently but having diverse kinds of education and experience […] Uniformity can be obtained only if the application is objective and not subjective, objective in the sense that the classification proceeds from the properties of the soil itself and not from the beliefs of the classifier about soils in general (Smith 1963, 6).

The most rigorously objective definitions were written in operational terms; that is, texture was not described as the size of a particle but the rate of settling when the surveyor followed a standard operating procedure. And to eliminate the confusion caused by recycled soil names, the authors invented an entirely novel, exquisitely logical nomenclature using Greek and Latin bases. The strict protocols and esoteric jargon of the *7th Approximation* exemplified the standardizing logic of imperial centers determined to eliminate the suspect, subjective judgments of observers stationed at the far flung outposts of a world-wide network of scientists – it epitomized the epistemic virtues of the view from above.

The system received mixed reviews. The most vigorous and substantial disagreements were over the wisdom of jettisoning the traditional genetic basis of classification. The argument for the objective criteria of morphological properties was compelling, but pedologists worried that the resulting system grouped soils on trivial grounds that produced meaningless associations. At FAO, A. J. Smyth, a British former colonial expert, wrote Guy Smith regarding the identification of agriculturally important soils of the Western Nigerian cocoa growing region; all the soils in this 9,000 square mile area seemed to belong in the same Subgroup (the fourth category down), "*providing they can be placed within a single Order*" (the highest category).[8] If Smyth's suspicions were true, then a small-scale map of West African soils would show multiple orders of soils in the area, while a larger scale map of Nigeria would show only one subgroup – a monstrous system. He nervously proposed an entirely new Order.

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[8] A. J. Smyth to Guy Smith, 27 April, 1966, Soil Classification and Correlation, April 1966-1972, LA-2/10, FAO (emphasis in the original).

In fact, Smyth's letter was understood as part of the process of perfecting the approximation. Elite soil scientists negotiated the definitions of categories and classes. Smith described the process of constructing the system:

> Members of a group representing unlike interests and experience see soils from a number of viewpoints. Different viewpoints toward soil produce different ideas about its classification. Consequently, compromises between the conflicting desires of a number of individuals are not only necessary but might actually produce a system with more general utility than a system which represents a single viewpoint. 'Compromise' may not be the exact word. The truth has many facets; each person has a somewhat different view of the truth, and no human can see the whole truth clearly. Our goal has been a blending of many views to arrive at an approximation of a classification that seems as reasonable as we can hope to reach with our present knowledge (Soil Survey Staff 1960, 11).

It follows that the greater the diversity of viewpoints included in the negotiations, the closer the "compromise" would approximate the truth. The epistemological logic and values of the view from everywhere, as well as the view from above, guided the production process of the *7th Approximation*.

Of course, classification systems were not intended to be philosophical exercises or sociological experiments; they were intensely practical endeavors. Beyond aiding memory and organizing information, the practical purpose of soil classification was to make soil maps. The larger the scale of the map, the lower the classification category it mapped. For example, detailed maps at a scale of 1:1,000-1:2,500 (used for designing irrigation, farm planning, and tax assessment) employed the lowest, most specific category; in the six-tiered system of the *7th Approximation*, this was the Soil Series. An individual Soil Series was named for the place it was first described; a soil individual would be called by its Series name. Semi-detailed maps at a scale of 1:50,000-1:100,000 (used for large-scale development planning) showed the next category up, the Family, or, more commonly, soil associations, which were complexes of Soil Series. Reconnaissance surveys (1:250,000-1:1,000,000) and schematic maps used the Great Group category, which was three levels of generalization above the Soil Series, and included 105 taxa (Table 1).

The *7th Approximation* emphasized properties thought to reflect the factors that had determined soil genesis at the higher categories, including the Great Group, and properties significant for soil behavior, especially behavior under cultivation, in the lowest two categories. A skilled soil scientist, therefore, could interpret the history of a region's soil from a small-scale map showing the distribution of Great Groups. And, since the Soil Series included all the properties defined at the higher categories plus those most pertinent to behavior, a detailed map revealed both a soil's past and possible futures.

Table 1: Soil Classification Categories and Corresponding Map Scales

Categories of U.S.D.A.'s 7th Approximation	Sample Scales and Uses of Maps
Orders	
Suborders	
Great Groups	Schematic maps: 1:1,000,000-1:5,000,000 Framework for more detailed studies Reconnaissance surveys: 1:250,000-1:1,000,000 Colonization of virgin land, national development planning
Subgroups	
Families (soil associations)	Semi-detailed reconnaissance surveys: 1:50,000-1:100,000 Large-scale development planning, pre-investment surveys, country maps
Soil Series	Detailed maps: 1:1,000-1:2,500 Farm planning, irrigation, land capability studies, tax assessment

Such possibilities suggest how the Soil Map of the World could be imagined as "the ultimate agricultural weapon." Yet, as the Nigerian cocoa soils suggested, the specific categories of the classification did not seamlessly telescope into the broader categories. Most strikingly, although the *7th Approximation* described the principles guiding the concept of the Family, soils had yet to be sorted into the category – it was essentially left blank, so a gap separated the relatively concrete entities in Soil Series from the more problematically abstract higher categories. This gap between the Soil Series and the Great Group raised serious questions about the practical utility of small-scale maps.

At any scale, the key practice on which all scientific soil mapping depended was correlation. Accurate correlation assured that experimental or experiential knowledge gained in one place could be extrapolated to other places with similar soils. Accurate correlation between soils in different places and on different maps meant any expert who knew the classification could interpret any map. If soils were poorly correlated – if soils were misnamed so that the same soils had different names on different maps or different soils had the same name – then the boundaries of the maps could be perfectly accurate, but the foundations of the whole cartographic system would be undermined. The correlator's job was to guarantee surveyors in the field met the standards of collective empiricism.

Instead of correlating soils within a classification system, however, the objective of the Soil Map of the World was to correlate the systems themselves. In practice, this involved the same negotiation and compromise, the same "blending of many views to arrive at an approximation of a classification" that Smith had described in the construction of the *7th Approximation*. The Soil Map of the World required the international correlation of national correlators.

In its simultaneous determination to control every detail of the observational practices of technicians in the field and its celebration of negotiation and compromise based on the experienced judgment of scientists, the *7th Approximation* manifested the tension between the view from everywhere and the view from above in the co-production of global environmental knowledge and international institutions. As Bramao wrote in a remarkably prescient 1954 memo essentially outlining the scheme followed by the Soil Map of the World, the project required

> the creation of […] small working groups, one per continent, to work on problems of nomenclature, classification and survey concerning their respective continents. These groups will serve the purpose best […] if they are formed of the smallest possible number of members […] from the most highly qualified scientists in the field.[9]

The scientific generals negotiated the view from everywhere; the standardized system they produced disciplined the troops in the field in order to produce a global view from above. This was, by design, an aggressively elitist endeavor. But perhaps by necessity, too – it is easier to criticize elite cosmopolitan projects than to imagine an alternative means of constructing global knowledge.

4. Making and Interpreting the Soil Map of the World

The World Soil Resources Office in Rome did resemble an imperial "center of calculation" of sorts. Making an inventory of the world's soil resources meant creating a databank of the world's soil knowledge. By the time the sheets were printed, the collection had grown to over 10,000 maps, 600 of which were the primary sources for the Soil Map of the World (FAO 1971-1981, vol. 1). This included all the soil maps officers could get their hands on; not just continental and country maps, but, for example, maps from large scale development projects and detailed surveys from FAO's experts in the field. The different projections of the small-scale maps had to be corrected for and most of the maps had to be reduced to the 1:5,000,000 scale. Many of the surveys had to be translated and some effort made to account for the different methodologies for analyzing and describing soils. The legends had to be correlated with the new international legend, which itself was continuously evolving over the course of the project's first decade. The variable reliability of the sources had to be constantly born in mind, too. As Paul Edwards emphasizes, making data global required as much work as making global data (Edwards 2010).

Still, an utter lack of global soil data posed a more obvious problem than the abundance of heterogeneous sources. No soil surveys had been conducted over most of the planet. For these areas, soils had to be inferred. Travelers' accounts, natural histories, agricultural data, and other written sources were useful, but the key to the methodology were other types of small-scale thematic maps: climatic and bioclimatic, vegetation and ecological, topographic, geolog-

9 FAO Program of Work in the Field of Soil Survey and Classification, 24 Sep. 1954, Land and Water Use Branch – Soils Survey + Classification (Luis Bramao), Box Land and Water Development Division, Land and Water Use Branch, chief Dr. R. Schickele, 10AGL566, FAO.

ic, and lithologic, and land use maps. These maps were easier than soil maps to produce without actually performing traverses. By superimposing as many thematic maps as possible and comparing the result to similar environments with known soils, scientists could make an educated guess about the classification of soils they had never touched. Moreover, since these thematic maps depicted the key soil-forming factors, brave souls could interpret them in the light of theories of soil genesis to deduce the morphology of soils. In genetic classification systems, after all, these maps represented the criteria of classification, especially at the higher categorical levels used for small-scale maps; for example, the Dokuchaev Institute's 1960 Soil Map of the USSR defined the "arctic half boggy soils type" in terms of information represented on climate, physiography, and vegetation maps. Of course, in an interdependent ecosystem, theoretically almost any meaningful variable could be deduced from the others. Natural vegetation maps, for instance, relied largely on soil, climate, and topographic maps to determine which tree ought to be the dominant species, even if that species were not actually present (Davis 2005).

Correlation could not be performed over drafting tables in an office in Rome, however. Correlation was a field science, but an intensely social one (Kohler 2002). For participants in the Soil Map of the World project, correlation meetings were the most exciting and rewarding part of the experience. The World Soil Resources Office coordinated around twenty soil correlation meetings, which featured two distinct sets of practices: technical discussions and study tours. In the discussions, representatives briefly reviewed their nations' survey histories, any small-scale national maps, and classification systems. Then the serious work began: analysis of tricky soils, unusual environments, and conceptual incompatibilities between systems.

The key document at these sessions was a correlation table, prepared by the World Soil Resources Office. A correlation table listed the national classification systems under discussion along the top row. Under these headings, it listed the hypothesized classifications of particular soils in each system. For example, the table for the second European soil correlation seminar (Table 2), held in Bucharest in 1963, proposed a correlation for soils according to the systems of Romania, Hungary, Bulgaria, the Dokuchaev Institute, the FAO-ECA Soil Map of Western Europe, and the 7th Approximation (FAO 1963a). The experts debated the accuracy of the correlation table and negotiated resolutions to apparent incompatibilities, which Dudal took into account in the next iteration. The legacy of the international conversation remains visible in the mix of traditional soil names, like Chernozems and Podzols, and newer invented names like Xerosols from the *7th Approximation*.

Table 2: Comparative Table of Soil Units from Second European Soil Correlation Seminar held in Romania, 1963

Romania	Hungary	Bulgaria	U.S.D.A 7th Approximation	Soil Map of Eastern Europe (Dokuchaiev Institute)	Soil Map of Western Europe (E.C.A.)
1. Light brown steppe soils	–	–	Vermustoll p.p.	Dark chestnut soils with pseudomycelium carbonates	–
2. Chestnut forest steppe soils	–	–	–	–	–
3. Calcareous chernozems	Chernozeme mit Kalküberzug (Pseudomyzelium)	Kabronathaltige Chernozeme mit flachliegenden Karbonatmyzelium	Vermudoll Vermustoll	Chernozems with surface pseudomycelium carbonates	–
4. Chernozems	Typische Chernozeme	Typische Chernozeme mit Karbonat-Myzelium	Vermudoll (in S. Romania on loess) Hapludoll (in more humid parts of Transylvania)	Chernozems with (high) pseudomycelium carbonates (S. Romania) Typical and ordinary chernozems (N. Moldavia)	Chernozem
5. Slightly and moderately leached chernozems	Ausgelaugte Chernozeme	Schwach und mäßig ausgelaugte Chernozeme mit tiefliegenden Kabonatayzelium	Hapludoll (Argudoll)	Chernozems leached with deep pseuomycelium cabronates (S. Romania) Chernozems podzolized and leached (N. Moldavia and Transylvania	Chenozem
6. Strongly leached chenozems	Chenozem-Braune Waldböden (ohne Textur B horizont)	Stark ausgelaugte Chernozeme mit tiefliegenden Karbonaten (schwache Lessivierung)	Argudoll	"	Brunizem p.p.
7. Chenrozems and leached chernozems in loessial microdepressions (toposequence)	–	–	–	–	–

Although natural and cultural factors both contributed to difficulties in reconciling national classifications, the whole project was based on the gamble that the cultural differences were more significant. Guy D. Smith's conclusion at the first European correlation seminar in Moscow was thus fundamentally optimistic, both for the scientific and internationalist objectives of the project: "The problems of correlation arose mainly from different approaches to classification rather than to the fact that the soils were different." The same laws of nature applied to soil genesis in the United States and Soviet Union, and so "reconciliation of present differences would be facilitated by visits of Russian colleagues to the North American continent" (FAO 1962, 3). During the depths of Cold War tensions, faith in the unity of nature justified hope in the transcendent ideals of scientific internationalism, and both can be read in the legend of the Soil Map of the World.

Differences had to be reconciled in the field. On study tours, scientists examined prepared profiles of typical or particularly interesting regional soils. A Romanian tour observed twenty-one soils in a week-long loop through the Eastern half of the country. An Indian tour investigated just twelve soils, but was notable for flying participants to see the three major soil regions of the country, around Delhi, Nagpur, and Mysore. Seeing the soil in its environment was essential to definitive correlation work, but the camaraderie of the field trips was also vital to another of the Soil Map of the World's principal objectives, to "strengthen international contacts in the field of soil science." During the 1960s, international scientific projects like the Soil Map of the World produced epistemic communities; that, more than more the production of reliable knowledge of the global environment, was their point.

At the 9th International Congress of Soil Science in Australia in 1968, Bramao and Kovda (who was elected president of the society at the meeting), presented the first draft of the Soil Map of the World, and the ISSS passed a resolution calling for its immediate publication. UNESCO published the complete set of maps over a decade, beginning with the sheets for North and Central America and the Legend in 1972 and ending with the explanatory volume for Europe in 1981. There was some irony in this order, since the Soil Map of Europe had been projected to be printed first in order to serve as a model for the other areas. Of course, North American experts only had to blend the viewpoints of two national soil survey organizations instead of twenty-seven independent agencies. But it also turned out to be far easier to produce schematic maps of Central America, Africa and South America, where there were fewer data, than to reduce the detailed view of Europe. More local knowledge made it increasingly difficult to capture the global view from above.

In the international soil science community, the map was hailed, and is still remembered, as an intellectual achievement that demonstrated the power of international scientific cooperation. Many nations produced national soil maps using the legend.[10] In the early 1990s, the FAO-UNESCO Soil Map of the World received the highest number of citations of any documents in a Core Agricultural Literature Project (McDonald 1994, 313). FAO aggressively promoted the classification presented in the legend as an international standard, especially through its regional training courses in underdeveloped areas, and the system became the main rival as an international standard to the final approximation of the U.S. Soil Survey Staff, *Soil Taxonomy*, published in 1975.

Despite the competition suggested by FAO's proselytizing, *Soil Taxonomy* and the FAO-UNESCO classification were intellectually quite compatible. But there was a key difference between *Soil Taxonomy* and the legend. Instead of a six-tiered hierarchy, the legend only listed Soil Units, which were equivalent to the American's Great Groups. In fact, I have found no evidence that participants even attempted to define lower categories. To do so would have jettisoned the critical advantage of small-scale mapping for the internationalist agenda; mutual understanding was easier when the details were blurred and the categories broad.

Each volume of the map, however, also included a thick appendix of descriptions of typical profiles (see fig. 2). These descriptions demonstrated the soil science community's prized epistemic virtues of precision, detail, and quantification. Thick qualitative descriptions of soil morphology were complemented by horizon depth measurements to the centimeter, color values keyed to the Munsell color chart (e.g. "yellowish brown [10yr 5/8]), particle size distribution calculated to a tenth of a percent, and a battery of chemical tests. The minimum size of an area delineated on a 1:5,000,000 map, on the other hand, is about 100,750 hectares (McCracken and Helms, 308). A gap several orders of magnitude wide separated the intensive detail of the profile descriptions from the extensive perspective of the map. The mono-categorical nature of the classification meant that the sense of groundedness provided by the profile descriptions was slippery; there was no taxonomic ladder to descend from the general properties of Soil Units to the specific properties of soil individuals. The patterns revealed by the global view from above applied to no place in particular.

Despite – or, perhaps, because of – this gap, the Soil Map of the World quickly proved to be a useful instrument of development planning. Scientists presented the sheets of the map as basic scientific documents. Their application required skilled interpretation for a particular purpose. The volumes of the Soil Map of the World included extremely small-scale maps of the area's bioclimatic regions, surface geology, physiographic regions, and potential natural vegetation. By superimposing these thematic maps on top of the soil maps, experts could estimate the potential and suitability of land for various types of agriculture. This process of isolating components of the environment and then reconstructing a

[10] E.g., Botswana, Egypt, Indonesia, Japan, Kenya, Mexico, Poland, Sierra Leone, Uruguay, and Zambia (FAO 1988).

simplified version of the whole illustrates the perpetual movement between analysis and synthesis that produced the view from above of the global environment.

The practice of interpreting the soil maps for development planning required that the maps presented objective descriptions of natural resources. Values and theories – interpretations – already were deeply embedded in the bioclimatic and natural vegetation maps in particular, however. Bioclimatic maps were constructed to be useful for specific agricultural regimes; potential vegetation maps portrayed a fictional natural world without humans. Soil maps themselves embedded theories about which properties were significant indicators of soil genesis and behavior under cultivation, as well as implicit assumptions about which types of plants mattered most. Re-enforcing this issue of compounding interpretations, these same types of thematic maps often had been used to infer the soil patterns in the first place. The interpretive methodology thus risked creating a closed, self-referential system.

The risks of this practice posed were intensified by the fact that the areas in which scientists depended most on inference were underdeveloped countries. These nations were the objects of development schemes that relied on international environmental knowledge sources because experts lacked local scientific data and practical experience. As environmental studies scholars have demonstrated, the false clarity provided by the view from above facilitated systematic misreadings of landscapes (ff. Davis 2007; Fairhead and Leach 1996; Thomas and Middleton 1994).

The Soil Map of the World and the data collected in the World Soil Resources Office proved important in the production of many other small-scale interpretive maps. Perhaps the most consequential of these maps depicted possible future worlds: for example, the FAO *Potential Population Supporting Capacities Maps of Africa* under varying levels of agricultural inputs; the United Nations Environment Program-FAO-UNESCO-World Meteorological Organization *Desertification Map of Africa*; and a *Soil Degradation Map of Northern Africa* (Dudal and Batisse 1978; FAO 1982; UNEP 1977). These interpretive maps did not merely visualize global resource inventories. They did not function as analogy generators intended to facilitate knowledge transfer. Their speculative nature was not justified by invoking their heuristic value. Instead, they fulfilled the promise of scientific map making; they enabled predictions. Governments superimposed yet another layer of economic and social data on top of the ecological maps to make predictions that justified development plans and changes in land tenure and agricultural techniques.

The interpretive flexibility of the map only compounded the seriousness of failures to achieve the ideals of the view from everywhere. The viewpoints of experts representing underdeveloped countries were underrepresented in the negotiations that produced the map's legend. During the 1960s, for example, the World Soil Resources Office did not host any soil correlation meetings in Africa. During the 1970s, however, FAO established international Soil Correlation and

Evaluation Sub-Committees for West and East Africa, which held seven meetings during the decade. These meetings included the requisite study tour, but while participants did correlate soils, the definition of classes in the legend was already fixed – the soils had to fit the preexisting categories. African scientists had little opportunity to adapt the international classification to their ends. In fact, African experts (and international experts working in Africa) expressed ambivalence about the whole exercise. For scientists from newly independent nations, gaining more accurate and useful knowledge of their as yet unanalyzed local soils – producing technical classifications – often seemed a more pressing matter than standardizing international nomenclature at the abstract level of the Soil Map of the World's natural system (FAO 1970, 1974; Edwards 2010, 197-200). After all, the natural classification was, by definition, useless.

5. Conclusion

Soil scientists and international civil servants appealed to catastrophic environmentalism to win the patronage of UN member states for a Soil Map of the World at a scale so small it applied to no place in particular. In the context of the Cold War and decolonization this strategy worked. The project appealed to the superpowers, which were committed to demonstrating their leadership of the conquest of hunger by sharing their technical expertise and spare change. Decolonization resulted in the rapid expansion of the international bureaucracy, and European experts from former colonial powers were the projects most ardent supporters and active contributors. But, while admittedly more subtle, the ideology of scientific internationalism was at least as powerful a motivation for mapping the world's spoils as Mathusian anxiety, Cold War rivalry, or the emergence of the Third World. More than international power politics, the intimate politics of bureaucracies and disciplines shaped the categories, boundaries, and colors of the Soil Map of the World.

Despite soil scientists' hedges regarding the map's utility, it was put to use as an instrument of development planning. Making the maps useful required he interpretive work that transformed a natural classification into a technical classification. Interpretation put the map in motion. It transformed the map from a metaphor of the world to a model of it. Ideally, the model's predictive value increased as experts superimposed more and more layers of thematic maps on top of each other. But it was also possible that the vivid patterns of the Soil Map of the World blurred as bioclimatic and potential vegetation, geologic and geomorphologic, land-use and population maps piled up. With the increasing density of data, the bright colors of the individual maps turned to black. The view from above projected a Rorschach blot.

But Soil scientists had never intended the legend to be more than another approximation. Indeed, soil scientists are right to celebrate this apparently useless map as a seminal achievement; it succeeded in cultivating an international community of soil scientists. And as a history of the next iteration of the legend of the Soil Map of the World would show, decolonization increased the representativeness of the UN's view from everywhere. The map was not a neutral artifact, but it was not necessarily a weapon of imperialist science or an instantiation of cosmopolitan internationalism either. Even as it helped make the fact of the global environment undeniable, it, like all such representations, remained open to interpretation.

Yet it would be a mistake to conclude that the world scale was merely an illusion. This would be equivalent to claiming the local scale was irrelevant because it could not be seen from high above. True, in an ideal functional world, the local and global scales would telescope seamlessly into each other; local and global patterns could be deduced from each other. But we live in a dysfunctional world – a world in which enduring patterns are nevertheless unpredictable. Given the necessary disjunction between scales in synchronic representations, the Soil Map of the World was a tremendous accomplishment. It could not determine policies, but it did contribute to the construction of a global environment about which it was possible to debate issues of aesthetics, equity, and sustainability.

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